Digital Communications

Academic Year: (2023 / 2024) **Review date: 19-04-2023**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: RAMIREZ GARCIA, DAVID

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Systems (Second year, first semester)
Communication Theory (Second year, second semester)

OBJECTIVES

Knowledge and management of the different techniques of digital communications (linear and non-linear, multi-carrier and spread spectrum), the structure of receivers and the basic techniques for protection against errors in digital communications.

Therefore, the objectives of this course are:

- Acquisition of the knowledge of mathematics and statistics that will be used as a tool to solve engineering problems in the context of digital communication systems.
- Design of a communication system with realistic constraints given by critical parameters such as cost, consume of power, bandwidth, transmission rate, and complexity.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Linear modulations:
   1.1 Baseband and bandpass PAM modulations
   1.2 Required bandwidth and analysis of noise in these modulations.
2. Receivers for digital communications
   2.1 The problem of inter-symbol interference
   2.2 Optimal receivers
   2.3 Structures for channel equalizers
3. Phase and frequency modulations
   3.1 Non-linear phase modulations
   3.2 Frequency modulations and continuous phase modulations
4. Multi-pulse modulations
   4.1 Multi-carrier modulations: required bandwidth and analysis of noise in these modulations
   4.2 Spread spectrum modulations: required bandwidth and analysis of noise in these modulations
5. Techniques for protection against errors
   5.1 Block codes
   5.2 Convolutional codes

LEARNING ACTIVITIES AND METHODOLOGY

Three teaching activities are proposed: Theoretical classes, exercise classes and laboratory exercises.

The ECTS credits include in all cases the personal work and group work to be carried out by the student.

THEORETICAL CLASS AND EXAMPLES (3 ECTS)
The theoretical class will be given in the blackboard, with slides or by any other means to illustrate the concepts learnt. In these classes the explanation will be completed with examples. In these sessions the student will acquire the basic concepts of the course. It is important to highlight that these classes require the initiative and the personal and group involvement of the students (there will be concepts that the student himself should develop).

CLASS EXERCISES (2 ECTS)
Before the exercise class, the student will have available the exercise list. The student should solve the exercises proposed in order to assimilate the concepts obtained in the theoretical class in a more

complex environment and to self-evaluate his knowledge.

LABORATORY EXERCISES (1 ECTS)
Basic concepts learnt during the course are applied by means of simulation. The student should participate actively on the exercise implementation; the level of the student involvement in this work grows from the first exercise to the last one where the student will be encouraged to propose and solve the problem.

ASSESSMENT SYSTEM

The final exam will determine 60% of the total course grade (6 points).
The rest of the grading 40% (4 points) is obtained along the academic year as follows:

1. At the end of some course chapters there will be one midterm exam with one or several exercises that will be solved in class.
2. Laboratory exercises. The laboratory exercises are MANDATORY.

The detailed rules and weights for the grading of each part will be provided at the beginning of the course.

It is necessary to obtain a minimun grade of 4 of 10 points in the final exam.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- A. Artés, F. Pérez, J. Cid, R. López, C. Mosquera, F. Pérez. Comunicaciones Digitales, Pearson Educación, 2007
- B. Sklar Digital Communications, Prentice Hall, 1988
- J.G. Proakis Digital Communications, McGraw-Hill, 2001